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Final Report for ROSAT NASA Grant NAG 5-1647

X-Ray Observations of Broad Absorption Line QSOs

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ROSAT PSPC observations of Broad Absorption Line QSOs (BAL QSOs) have been obtained as a result of the AO-1 and AO-2 programs. The programs are related and have two primary objectives. The first objective is to form a complete, flux limited sample of luminous BAL QSOs at moderate redshift which will permit a comparison of the X-ray properties of 'normal' BAL QSOs with those of 'normal' radio quiet and radio loud QSOs. The comparison will ultimately allow us to refine or refute the favored idea that the covering factor of the BAL region gas is small and constrain models for the BAL region and X-ray and optical continuum emitting region geometries. The second aim is to make observations of to investigate the chemical composition and physical conditions of the BAL region gas by searching for photoelectric absorption. With these observations we will be able to test past results which suggest that the metal abundances of the BAL gas may range in excess of 100 times the solar value.

While some of our proposed targets were approved for observation in AO-1 and AO-2 (and one additional target was given supplementary status in AO-3), it is unlikely that our sample of four 'normal' luminous BAL QSOs is large enough to properly realize our first objective. On the other hand, we have obtained sufficient data to consider our second objective.

Up to now, most of our work has involved assessment and evaluation of the ROSAT images. We have the IRAF PROS software up and running in Pittsburgh. We have also made three trips to ROSAT data analysis centers (1 trip to GSFC and 2 trips to CfA, including the recent November 1992 ROSAT meeting in Boston) in order to receive instruction and advice on the processing and analysis of the ROSAT data. As appears to be the case with most ROSAT investigators, we have had to deal with observation scheduling, data distribution, data calibration, and/or instrumental problems during the course of the program.

While we still need to propose for future pointed observations to investigate an appropriately large sample of luminous moderate redshift BAL QSOs, synthesis of the optical to x-ray spectrum and preliminary analysis suggests that we may have evidence for intrinsic photoelectric absorption in at least one object for which we received an unusually long PSPC observation.

If the metal abundance of the BAL gas is as high as has been inferred from optical spectroscopy and ionization equilibrium calculations (i.e., metal abundances which are enhanced up to 100 or more times solar values), photoelectric absorption in the object should be detectable in the PSPC 0.1-2.4 keV band. We note that the abundance enhancements which have been inferred thus far from BAL QSO observations are certainly large enough to indicate that the study of BAL gas may be providing an important clue for identifying previously unrecognized sources of nucleosynthesis at early epochs.

Finally, the ROSAT observations are also generally helping us to better define the form of the ionizing continuum in BAL QSOs which is important to calculating models of the BAL region level of ionization.